IOSR Journal Of Pharmacy and Biological Sciences (IOSR-JPBS)
e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 20, Issue 4 Ser. 3 (July. – August. 2025), PP 54-58
www.Iosrjournals.Org

Study Of Repeated Exposure Of Cement Dirt And Its Persistent Consequences On Electrolytes And Osmolality In Serum And Urine Among Male Cement Handlers At Dalmia Bharat Cement Plant

Zamiruddin Ansari[*1], MD Muntasar[2], Shahbaz Uddin Ansari[3]

[*1]*Biochemistry Department, Shyamlal Chandrasekhar Medical College, Khagaria-851205, Bihar, India*
[2]*Physiology Department, Shyamlal Chandrasekhar Medical College, Khagaria-851205, Bihar, India*
[3]*M.E (Health, Safety And Environment Engineering), Chandigarh University, Chandigarh, India*

Abstract
Background: *According to the current study, cement male handlers at Dalmia Bharat Cement Plant had persistent effects of toxic cement dirt exposure on the level of electrolytes (Sodium, Potassium and Calcium) and osmolality in serum and urine respectively. The study found that repeated and protracted exposure of toxic cement dirt, depending on sensitivity and duration; have led to environmental health risks, adverse effect on serum and urine levels of electrolyte and osmolality among cement dirt exposed factory workers.*
Materials and Methods: *The study involved a total of 120 participants. Among participants, 60 were workers directly exposed to cement dirt, referred to as Cement Handlers (CH), due to their job responsibilities over the past eight years. The remaining 60 participants, who had no exposure to cement dirt, served as controls and were classified as Non-Cement Handlers (NCH), consisting of office staff within the same factory. Cement handlers were susceptible to cement dirt for about 8 hours each day, weekly 6 days. Blood specimens were collected by paramedical staff at the plant and were transferred to specific blood vacationers and sterile urine containers and quickly sent to a clinical biochemical laboratory for analysis, where serum and urine levels of electrolytes and osmolality was determined.*
Results: *Results of current study unveiled significant association of environmental pollution mediated occupational health risk with changes in electrolytes and osmolality in serum and urine of cement*

handlers (CH) when compared with non-cement handlers (NCH) as persons control of Dalmia Bharat Cement Plant. In this research the serum levels of sodium (Na^{+}) and potassium (K^{+}) were increased while serum calcium (Ca^{++})as well asserum osmolality levels were decreased in cement handlers significantly. In the urine samples, the levels of sodium, potassium, calcium and osmolality were significantly higher among cement dust exposed workers or cement handlers when compared with unexposed non cement handlers.
Conclusion: *The study's conclusion depending on sensitivity and duration; finds cement dirt exposure has detrimental effect on electrolytes and osmolality in serum and urine among cement handlers (CH) when compared with non-cement handlers (NCH) as persons control of Dalmia Bharat Cement Plant.*
KeyWord: *Cement dirt, Environmental pollution, Electrolytes, Osmolality, Cement factory workers*

Date of Submission: 14-08-2025 Date of Acceptance: 24-08-2025

I. Introduction

An intolerable number of health problems, have always been caused by environmental pollution importantly toxic cement dirt. Due to persistently high levels of construction development activity, the emerging market has seen an increase in demand for cement manufacturing [1–4]. The many stages of cement manufacture, such as clinker cooling, raw material grinding, rotating kilns, packaging facilities, and storage units, produce dirt and other airborne particles [5–6]. Lime, silica, alumina, and iron oxides make up the majority of the basic ingredients required to make cement [7]. Silica exposure can cause acute silicosis; can trigger internal organ's damaging effect from occupational toxic cement dirt exposures [8]. Exposure to toxic cement dirt has been an alarming environmental pollution issue that may cause injury to organ systems and tissues [9–10]. Cement dirt enters our bodies by eating, inhalation, and epidermal exposures, to a lesser degree [11]. Till now few researches have been done to investigate the deleterious effects of toxic cement dirt on the levels of electrolytes and osmolality in blood and urine samples of factory workers [12]. Pollution from the environment and the workplace is now a direct risk factor for the lung function and development of fatal

systemic diseases [13]. Hence it is of utmost important to recognize those components of environmental pollutants and causative risk factors or markers of various types of pathogenesis [14]. The current study has explored the persisting consequences of exposure to cement dirt at work on serum and urine electrolytes (sodium, potassium and calcium) and the osmolality respectively among cement handlers at Dalmia Bharat Cement Plant at Kalyanpur, Banjari, Bihar state of India. A key strength of this research is its novel approach in assessing the long-term and detrimental effects of cement dirt exposure, an area that has not been sufficiently explored.

II. Material And Methods

The study involved a total of 120 participants from the Dalmia Bharat Cement Plant located in Kalyanpur, Banjari -821303, Bihar, India. Among participants, 60 were workers directly exposed to cement dirt, referred to as cement handlers (CH), due to their job responsibilities over the past eight years. The remaining 60 participants, who had no exposure to cement dirt, served as controls and were classified as non-cement handlers (NCH), consisting of office staff within the same factory. The participants had been employed in the cement industry for an average of 94.15 months (±3.85 months), which is approximately 7.85 years. Cement handlers were susceptible to cement dirt for about 8 hours each day, weekly 6 days. Blood and urine specimens were collected by paramedical staff at the plant .Total of 5 ml of blood was drawn using the vein-puncture technique and urine samples were collected from each participant during fasting state, between 7:00 and 9:00 AM,. These blood samples were transferred to serum separator tubes (SST) whereas the collected urine samples were split into the sterile containers and plain tubes. First the urine sample of the container was directly used for the electrolytic determinations, whereas the urine sample in tube was centrifuged for 15 minutes at 3000 rpm, the supernatant obtained are used for osmolality determination. All three specimens were sent to a clinical biochemistry laboratory where serum and urine electrolytes were determined based on ion selective electrode(I.S.E. indirect) method using a fully automated Hitachi 912chemistry analyzer manufactured by ROCHE, Germany. Osmolality in serum and urine (frozen samples) was determined by cryometric method.

Exclusion criteria: Workers with a history of blood transfusions, alcohol use, cigarette and shisha smoking, anemia, asthma, cardiovascular illness, or cancer were not allowed to work. In order to lessen the impact of obesity, workers with a BMI exceeding 30 kg/m² were excluded from the study. Participants in this study were also excluded if they had ever worked in any other business that emits dirt or fumes.

Ethical clearance: The Department of Research and Development's Ethical Committee and Review Board of Chandigarh University in Chandigarh fully authorized the protocol. Researched performed compliance with the ethical criteria that are comparable to the "1964 Declaration of Helsinki" and its later revisions [15]. [ERB/2015/17, Reference No.: DRB-PUC.] In Kalyanpur, Banjari, Bihar, the Dalmia Cement Factory's management authority obtained prior consent. Every participant was informed of the goal of the study. Every participant completed an informed consent form and willingly participated in the study. Researchers assured them of the confidentiality of their personal information, and coding was completed thereafter.

Statistical analysis: Full filled using ANOVA or the Student's paired t-test to compare two groups based on paired data at different significance levels. The data of determinations were expressed using mean ± S.E. A probability value that was statistically significant ($p < 0.05$) was taken into consideration.

Data collection: This is case-referent study; information was obtained from employees through in-person interviews that were conducted in both their native tongue and English. Employees who met the inclusion criteria were informed about the research objectives, and then they submitted necessary data to full fill survey [16]. Workers participating in tasks such as bagging, loading, grinding, and crushing were exposed to the greatest quantities of cement dirt in their immediate area.

III. Result

The anthropometric index (BMI, Weight& Height) and mean age of the cement dirt exposed cement handlers (CH) assigned as test groups and non-cement handlers (NCH) assigned as control groups were shown in Table no 1. An analysis of anthropometric measurements performed. Significant differences ($P < 0.05$) were seen in BMI and waist-to-hip ratio (WHR) between cement handlers and non-cement handlers. Most of the research among workers of cement factory focused on impact of cement dirt on their respiratory system. However it is well thought that cement dirt may affect selected renal function markers too. In order to assess long term consequences of cement dirt exposure on selective renal markers among factory workers; the electrolytes and osmolality were estimated in serum and urine samples from cement handlers and non-cement handlers. The levels of serum levels of sodium and potassium mere significantly higher ($P<0.05$) while serum

calcium and osmolality levels were significantly lower (P<0.05) in cement handlers. In the urine samples, the levels of sodium, potassium, calcium and osmolality were significantly higher while urine osmolality was significantly lower in cement dust exposed workers when compared with corresponding levels in controls. The data is seen as in Table no. 2 and 3.

Table no1: The socio-demographic profiles of 120 individuals, consisting of Cement Handlers (CH) and Non-Cement Handlers (NCH) at Dalmia Bharat Cement Plant, were examined.

Variables	NCH (n=60) (Range)	CH (n=60) (Range)	P – Value
Age (Year)	34.07 ± 2.89	38.94 ± 2.89	> 0.05*
	(22.0 - 42.0)	(27.0 – 47.0)	
Weight (Kilogram)	59.57 ± 2.40	62.08 ± 5.2	< 0.05
	(48.0 – 69.0)	(50.0 – 70.0)	
Height (Centimeter)	159.70 ± 5.71	164.60 ± 4.97	< 0.05*
	(142.0 – 178.0)	(146.0 – 169.0)	
BMI (meter/Kilogram^2)	24.05 ± 1.99	22.55 ± 2.05	< 0.05*
	(20.5 – 24.5)	(18.5 – 24.5)	
Ratio of Waist to Hip (centimeter)	79.8 ± 3.05	90.2 ± 3.60	< 0.05*
	(<94.0)		

Note: * Significant at p < 0.05; ** Significant at p < 0.01; values are given as Mean ± S.E.
Abbreviation: BMI =Body Mass Index

Table no 2: Impact of exposure of cement dust on tests on serum electrolytes and osmolality among non-cement handlers (NCH) and cement dust exposed CH at Dalmia Bharat Cement Plant.

Serum Parameters		NCH (Range) (n=60)		CH (Range) (n=60)	P – Value
Serum Na^+ (mMol/L)		140.05 ± 4.95 (133 - 146)		163.32 ± 0.09	< 0.05*
Serum K^+ (mMol/L)		4.40 ± 0.36 (3.5 – 5.5)		9.50 ± 1.49	< 0.05*
Serum Ca^{++}(mMol/L)		3.93. ± 0.43 (2.2 – 2.7)		2.44 ± 0.30	< 0.05*
Serum Osmolality (mOsmole/kg of solvent)		291.22 ± 6.02 (280 – 300)		114.68 ± 5.18	< 0.001**

Note: * Significant at p less than 0.05, ** Significant at p less than 0.01; values are given as Mean ± S.E.
Abbreviation: Electrolytes with the symbols Na+, K+, Ca++ are sodium, potassium, and calcium respectively.

.

Table no 3: Impact of exposure of cement dust on tests on urine electrolytes and osmolality among non-cement handlers (NCH) and cement dust exposed CH at Dalmia Bharat Cement Plant.

Urine Parameters		NCH (Range) (n=60)		CH (Range) (n=60)	P – Value
Urine Na^+ (mMol/L)		126.59 ± 3.89 (133 - 146)		145.60 ± 4.13	< 0.05*

Urine K^+ (mMol/L)		3.96 ± 0.67* (3.5 – 5.5)		6.57 ± 0.63	< 0.05*
Urine Ca^{++} (mMol/L)		4.76 ± 1.38 (2.2 – 2.7)		7.70 ± 1.72	< 0.001**
Urine Osmolality (mOsmole/kg of solvent)		295.88 ± 11.92 (50 – 1200)		489.15 ± 12.31	< 0.001**

Note: * Significant at p less than 0.05, ** Significant at p less than 0.01; values are given as Mean ± S.E.
Abbreviation: Electrolytes with the symbols Na+, K+, Ca++ are sodium, potassium and calcium respectively.

IV. Discussion

As best to knowledge, this solitary conducted in Bihar, state in India, that investigates pollution of air and environmental health maladies among Dalmia Bharat Cement Plant workers, focusing on linking prolonged (about 8 years) and potential effects of occupational exposure of cement dirt with the levels of serum and urine electrolytes and osmolality as of very few studies were carried out in Indian states excluding Bihar.Between exposed and unexposed conditions, the values of Na+ and K+ demonstrate notable difference. Our results show significant elevation ($P < 0.05$) of serum and urine levels of sodium and potassium in cement dirt exposed cement handlers. In a similar study the slight elevation of sodium and potassium have been shown due to relative hemoconcentration the exposed group as a result of mild dehydration and stress [17]. Our result has revealed significant decreased in the serum level of calcium

($P < 0.05$) in exposed group. It is noticeably different when comparing the people who were not exposed to cement dirt. Similarly finding was obtained in earlier study [18]. This might be caused by the pressure from the high concentration of alkali oxides, and other metals namely: oxides of calcium, iron and silicon, aluminum trioxide and magnesium in cement [19]. Studies are available on cement dust and osmolality but most of them were done without taking the long-term duration response impact into account with exposed workers age correlation [20]. However present study revealed that the prolonged exposure of cement dirt had significantly reduced the levels of serum osmolality ($P < 0.001$) especially among cement dust exposed cement handlers when compared with control subjects at Dalmia Bharat Cement Plant. The observed reduction in serum osmolality could be the indirect effect of toxic cement dirt on the lung function especially forced expiratory volume and then this effect could be behind the reduction of serum osmolality. Ours results align to previous studies [21-22] that serum hypernatremia could induce the body to secrete more sodium and other electrolytes like calcium in urine and hence increase the ratio of these solutes in the secreted urine which ultimately leading to increase in osmolality [23]. The present study discloses that prolonged and recurrent exposures, based on the length of time, degree of exposure, and personal sensitivity, hazardous cement dirt significantly influenced serum and urine levels of electrolytes and osmolality among workers in the cement industry internationally.

V. Conclusion

The current research endeavor sought to examine the prolonged, uncontrolled and repeated exposure of cement dirt on serum and urine level electrolytes and osmolality specifically among Dalmia Bharat Cement Plant workers. Continuous inhalation, ingestion, dermal contacts make even the minor concentration of toxic cement dirt a major concern to their health. This research study revealed that persistent and prolonged toxic cement dirt exposures, contingent on the sensitivity and length of time of factory workers have significantly influenced the electrolytic balance and osmolality in serum and urine samples of cement handlers when compared to their counterpart non-cement handlers. The current research study has explored that the toxic cement dirt pollutants are significantly associated with alterations in electrolytes sodium (Na^+), potassium (K^+), calcium (Ca^{++})and osmolality levels in occupationally exposed group. These selected parameters are said to be the sensitive index that could be useful as an indirect predictive or distinctive tool in assessing the toxicity of cement dirt. The health-related complications might exacerbate if the exposure to cement dirt among cement handlers is not controlled.

Conflict of interests
There are no conflicts of interest pertaining to the publishing of this research, according to the authors.

Acknowledgment

I, Zamiruddin Ansari, would like to thank the workers of Dalmia Bharat Cement Plant at Kanyanpur, Banjari, District Rohtas, Bihar, Indiawho voluntarily participated along with phlebotomists , laboratory technicians of biochemistry department, Narayan Medical College, Jamuhar, District Rohtas, Bihar, India for their valuable and timely support during the entire study.

References

[1] Ahmad, R., Shamima, Q., And Haque, M. Occupational Cement Dust Exposure And Inflammatory Nemesis: Bangladesh Relevance. J. Inf. Res. 2021; 14: 2425 – 2444.
[2] EL – Abssawy, A. A., Hassanien, M.A., Ibrahim,Y.M., Abdel Latif, N.M 2011. Health Risk Assessment Of Workers Exposed To Heavy Metals In Cement Kiln Dust (CKD). J. Am. Sci. 7 (3): 308 – 316.
[3] Krishna, L., Pandarikkal, J.R., Sreedharan, R., Sampson, U., Amamala, P.T., Unni, K. 2019. Assessment Of Respiration Morbidity Among Loading And Unloading Workers Exposed To Cement Dust. Int. J. Res. Med. Sci. 7(6): 2422 – 2427.
[4] Meo SA, Muneif YAB, BenomranNA, AlsadhanMA, Hashem RF, Alobaisi AS. Prevalence OfPre Diabetes And Type 2 Diabetes Mellitus Among Cement Industry Workers. Pak J Med Sci. 2020 Jan-Feb; 36 (2):32-36.
[5] Gupta, R. K., Majumar, D., Trivedi, J.V., Bhanarakar, A 2012. Particulate Matter And Elemental Emission's From A Cement Kiln. Fuel. Process. Technol. 104: 343 – 351.
[6] Uddin, M.T. And Chaudhary, I.M. Sustainable Development Of Concrete Construction Material In Bangladesh: 1st IUT International Seminar On Sustainability, Recycling And Durability Of Concrete, Department Of Civil And Environmental Engineering, Islamic University Of Technology (IUT). March 17, 2021.
[7] Ansari, S And Arora, N. Study Of Uncontrolled Cement Dust Exposure And Its Prolonged Effects On Glycemic Status And Renal Function Markers Among Male Cement Handlers At Dalmia Cement Factory. J. Chem. Health. Risks. 2023. 13(6), 1090-1095 | ISSN: 2251-6727
[8] Jude, C.A.L, Sasikala, K; Ashok Kumar, R; Sudha, S; Raichel, J. Haematological And Cytogenetic Studies In Workers Occupationally Exposed To Cement Dust. Int. J. Hum. Genet; 2002; 2(2):95-99.
[9] OSHA Report. Silica, Crystalline. Washington, DC, USA: Occupational Safety And Health Administration. March 2, 2018.
[10] Murugadoss, S., Lison, D., Godderis, L., Brule, S.V.D., Mast, J., Brassinne F., Sebaini, N., Hoet, P.H 2017. Toxicology Of Silica Nanoparticles: An Update. Arch. Toxicol. 91(9): 2967 – 3010.
[11] Mayeux, J. M., Escalante, GM., Christy, J.M. Pawar, RD., Kono, D.H., Pollard, K.M. 2018. Silicosis And Silica – Induced Autoimmunity In The Diversity Out Bred Mouse. Front. Immunol. 9: 874 – 877.
[12] Al-Mamori NAH, Al-Taee NSN. Effect Of Cement Dust On Electrolytes And Osmolality In Serum And Urine Of Kufa Cement Factory Workers. July-September, 2020, 14 (3):1605-1609.
[13] Shahnawaz Rampuri. "Study And Analysis OfOccupational &Health Diseases In Cement Industries." International Journal OfAdvance Research, Ideas And Innovations In Technology 2.3 (2017).
[14] Ansari FA, Bihari V, Rastogi SK, Ashquin M, Ahmed I. Environmental Health Survey In Asbestos Cement Sheets Manufacturing Industry. Indian J Occup. Environ. Med. 2007; 11:15-20
[15] Carlson RV, Boyd KM, Webb DJ. The Revision Of The Declaration Of Helsinki: Past, Present And Future. Br. J. Clin. Pharmacol. 2004 Jun; 57(6):695-713.
[16] Bassey, I.E., Akpan, U.O., Nehemiah, E.D., Arekong, R., Okonkwo, L., Udoh, A.E. 2017. Cardiovascular Disease Risk Factors And Cardiac Markers Among Male Cement Workers In Calabar, Nigeria. J. Chem. Health. Risks. 7(2): 85 – 94.
[17] Goldsmith, J.R. And Goldsmith, D.F. 1993. Fiberglass Or Silica Exposure And Increased Nephritis Or ESRD (End – Stage Renal Disease). Am. J. Ind. Med., 23: 873 – 881.
[18] Pogson, Z.E.K., Mckeever, T.M. And Fogarty, A. The Association Between Serum Osmolality And Lung Function Among Adults. Eur. Respire. J. 2008, 32: 98-104.
[19] Akinola, M.O., O Kwok, N. A. And Yahaya, T. The Effects Of Cement Dust On Albino Rats (Rattusnorvegicus) Around West African Portland Cement Factory In Sagamu, Nigeria, Res. J. Env. Toxicol. 2008., 2: 1 – 8.
[20] A Kahara, C.O. 1994. A Study Of The Respiratory Disorders Of Cement Factory Workers In Nkalegu, Enugu State, FMCPH Thesis.
[21] Hassan, A.A., Osman, H.M., Musa., O.A., Ali, I.A. Reference Values For Serum Electrolytes (Sodium, Potassium, Calcium) In Khartoum State. Saudi J. Med.Pharm.Sci..2018; 4: 753 – 757.
[22] Al-Fadhel, S.Z.BiochemicalStudy For Electrolyte (Na^+ And K^+) And Lipid Profile Levels In Kufa Cement Factory Workers. J.Kufa.Chem.Sci.2013 (7):11-17.
[23] Vadi, S, And Yim, K. Hypernatremia Due To Urea-Induced Osmotic Diuresis: Physiology At The Bedside. Indian. J.Crit.Care.Med. 2018.22:664-669.